

A RESPONSE CONFLICT ACCOUNT OF THE EFFECTS OF STEREOTYPES ON RACIAL CATEGORIZATION

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Research indicates that racial categorization is slowed by the presence of category-inconsistent information. The current experiments tested response conflict, or the tendency for opposing response tendencies to compete for activation, as a mechanism for this effect. In two experiments, participants more quickly categorized faces flanked by racial stereotype-congruent words than faces flanked by stereotype-incongruent words, particularly when stereotype-congruent words were more probable. Event-related potential (ERP) data indicated that this behavioral effect was due to response conflict. The lateralized readiness potential (LRP) showed that, relative to stereotype-congruent flankers, stereotype-incongruent flankers initially elicited activation of the incorrect categorization response, which slowed activation and execution of the correct categorization response. Stereotype-incongruent flankers also enhanced the amplitude of the N2 (conflict monitoring) component. Potential differences in stimulus evaluation time, assessed with the latency of the P3 component of the ERP, were not responsible for observed response time differences. Findings are discussed in terms the neural locus of behavioral effects.

A fundamental aspect of person perception is that people tend to be seen, first and foremost, as members of a social category (e.g., Brewer & Feinstein, 1999; Fiske, Lin, & Neuberg, 1999). Categorization happens very quickly (e.g., Banaji & Hardin, 1996; Zarate & Smith, 1990) and effortlessly (see Fiske, 1998), often on the basis of visually prominent and culturally relevant features such as race, sex, and age (see Brewer & Feinstein, 1999; Fiske, 1998; Fiske et al., 1999). This seemingly natural tendency to rapidly categorize others has a number of advantages, such as

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reducing the complexity and amount of information needed to form a basic understanding of a social target (see Bodenhausen, Macrae, & Sherman, 1999). However, such benefits do not come without costs. Primary among these is that social categorization leads to the activation of stereotypes (see Bodenhausen & Macrae, 1998; Bodenhausen et al., 1999; Fiske, 1998), which ultimately constrain how social targets are perceived. For example, activation of racial categories leads to heightened accessibility of stereotype-related constructs in memory (e.g., Dovidio, Evans, & Tyler, 1986; Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Fazio, Jackson, Dunton, & Williams, 1995; Gaertner & McLaughlin, 1983) and causes targets to be viewed in more stereotypical terms (see Wheeler & Petty, 2001).

People often are motivated to overcome the influence of stereotypes in order to avoid responding to targets primarily on the basis of a category such as race (e.g., Fiske & Neuberg, 1990; Monteith & Voils, 2001; Plant & Devine, 1998). However, doing so is generally thought to be effortful, requiring top-down control over well-learned, automatically activated racial biases (e.g., Devine, 1989; Payne, 2005; Payne, Shimizu, & Jacoby, 2005; see also Monteith & Voils, 2001). Situations in which appropriate responding requires increased control often are characterized by conflict between a well-learned but situationally-inappropriate response tendency and an alternative, more appropriate response. The Stroop color naming task (Stroop, 1935; also see MacCleod, 1991) provides a classic laboratory demonstration of the influence of such response conflict on behavior. On congruent trials (e.g., the word RED printed in red ink), both prepotent word reading and task-appropriate color naming produce the same response, and thus responses tend to be fast. On incongruent trials (e.g., the word RED printed in blue ink), however, word reading and color naming produce divergent responses, leading to conflicting response tendencies that slow response output.

Many tasks commonly employed in the categorization and stereotyping literature, in which participants respond to stereotype-related words or images in the presence of a race cue, also could be considered examples of response conflict tasks. For example, a number of researchers have used sequential priming tasks in which faces or words depicting racial categories are presented briefly, just prior to the onset of words that participants are asked to quickly identify as positive or negative (e.g., Fazio et al., 1995; Fazio & Dunton, 1997) or as descriptive or not of the preceding target person (e.g., Dovidio et al., 1986, 1997). In general, participants can more quickly respond to words that are stereotypically congruent with the racial category of the prime than to stereotype-incongruent words. Such priming effects often have been interpreted in terms of a spreading activation process (e.g., Neely, 1977; Collins & Loftus, 1975), whereby presentation of a racial cue temporarily increases the accessibility of category-consistent constructs, facilitating responses to words representing those constructs (see Fazio et al., 1995). However, response conflict also could account for such findings if the presence of the racial category prime activates response tendencies associated with category-consistent attributes. That is, on congruent trials the response activated by the prime is the same one activated by the target (i.e., no conflict), leading to a faster target response, whereas on incongruent trials the responses activated by the prime and the target oppose one another (i.e., high conflict), thereby slowing execution of the target response.

A number of recent reports have conceptualized performance in stereotyping tasks in terms of conflict and control processes (e.g., Amodio et al., 2004; Bartholow, Dickter, & Sestir, 2006; Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005;

Payne, 2001, 2005; Payne et al., 2005). For example, Payne and colleagues have demonstrated that misidentification of a harmless object (a tool) as a gun following a Black face prime occurs due to a failure of control to overcome the automatic bias associating Blacks with violence (Payne, 2005; Payne et al., 2005). Amodio et al. (2004) provided evidence that such race-biased weapon misidentifications are accompanied by enhanced activation of the neural conflict monitoring system (cf., Botvinick, Braver, Barch, Carter, & Cohen, 2001). However, the extent to which conflict in such tasks results from activation of multiple response channels in a single trial, and whether this response conflict is associated with differences in reaction times on stereotype-consistent and -inconsistent trials, has yet to be determined.

The main purpose of the current research was to specify the role of response conflict in understanding stereotype congruence effects in a reaction time task. Specifically, we sought to determine the extent to which racial categorization is slowed by the presence of stereotype-incongruent trait information because that information surreptitiously activates an opposing categorization response. In order to directly link this research with the larger literature on conflict and control (e.g., see Botvinick et al., 2001), we used a modified version of a well-known conflict paradigm, the Eriksen flanker task (Eriksen & Eriksen, 1974). In a typical flanker task, participants respond to central target letters flanked on both sides by other letters that elicit either the same response as the target (HHHHH or SSSSS; compatible trials) or the opposite response (SSHSS or HSHSH; incompatible trials). The common tendency for participants to respond more slowly on incompatible trials is termed the *compatibility effect* (e.g., Eriksen & Schultz, 1979; Gratton, Coles, Sirevaag, Eriksen, & Donchin, 1988). There generally is consensus that the compatibility effect is the result of increased response conflict occurring on incompatible trials (e.g., Botvinick et al., 2001; Coles, Smid, Scheffers, & Otten, 1995; Eriksen, Coles, Morris, & O'Hara, 1985). In the current studies, participants racially categorized pictures of Black and White men's faces that were flanked by words associated with common stereotypes of Blacks and Whites. An important difference between this task and a typical flanker task is that the flankers in the current paradigm are not directly mapped to either response, but share only an implicit, stereotypical association with the target. Therefore, any conflict would be the result of stereotyping per se rather than physical features of the stimuli or experiment-specific response mapping.

Although many stereotyping tasks involve a sequential priming technique in which a prime temporally precedes the onset of a target stimulus, a flanker task has a distinct advantage for testing the role of conflict in stereotype-congruence effects. This is because sequential stimulus presentation could readily produce conflict-like effects simply because the prime produces some degree of response activation prior to target onset, thereby giving one response a "head start." The simultaneous presentation of all stimuli on each trial in the flanker task avoids this issue, thereby providing a more conservative test of the response conflict hypothesis.

In addition to manipulating flanker compatibility (i.e., stereotype congruence), we also manipulated the probability of compatible and incompatible trials. Gratton, Coles, and Donchin (1992) showed that the size of the compatibility effect varies along with the probability of compatible trials. This finding was interpreted in terms of strategic allocation of attention (see also Bartholow et al., 2005; Botvinick

et al., 2001). When compatible trials are more frequent, participants adopt a strategy whereby attention is directed broadly to the entire stimulus array. Doing so facilitates correct responding when the flankers and target elicit the same response (i.e., compatible trials), but makes responding more difficult—presumably, by enhancing response conflict—when the flankers and target elicit opposing responses (i.e., incompatible trials). In contrast, when incompatible trials are more frequent, focusing attention on the target is a more effective strategy for quick and accurate responding. Another aim of this research was to determine whether a similar strategic process would occur during a racial categorization task when the flankers could provide information about target identity only indirectly.

The Neural Locus of Behavioral Effects

The question of whether any observed stereotype congruence effects are the result of response conflict as opposed to some other process can be cast as one of identifying the locus of response latency differences. It could be that race is more difficult to visually categorize when presented in the context of category-inconsistent information (see Livingston & Brewer, 2002; Richeson & Trawalter, 2005). This would suggest that the locus of slower responses on incongruent trials is in the stimulus evaluation process. Alternatively, it could be that targets are evaluated similarly regardless of their context but that the competing representations of multiple stimuli lead to activation of opposing responses within the same trial. If so, the locus of the effect could be in the response output process. Of course, it is also possible that multiple processes could be affected.

Event-related brain potentials (ERPs) provide a way to test these possibilities. ERPs are aspects of the scalp-recorded electroencephalogram (EEG) that represent the timing and level of engagement of various information processing activities (see Fabiani, Gratton, & Federmeier, 2007). ERP components often are described in terms of their polarity (positive or negative deflections from baseline) and the order in which they typically appear following stimulus onset. One component, the N2, is often enhanced on incongruent trials in response conflict tasks (e.g., Bartholow et al., 2005; van Veen & Carter, 2002), which has led to the hypothesis that the N2 reflects the activity of a conflict monitoring mechanism (see Botvinick et al., 2001; Nieuwenhuis, Yeung, van den Wildenberg, & Ridderinkhof, 2003). Another component, the P3, has been associated with stimulus categorization and evaluation processes. Specifically, the latency at which the P3 peaks following stimulus onset is thought to reflect the speed with which the stimulus is categorized and its evaluative implications understood. This idea is supported by the finding that as categorization becomes more difficult, P3 latency increases (e.g., Kutas, McCarthy, & Donchin, 1977). In some cases the flanker compatibility effect is mirrored in P3 latency, suggesting that the effect can stem at least in part from differential evaluation of compatible and incompatible arrays (see Coles, Gratton, Bashore, Eriksen, & Donchin, 1985). Finally, the lateralized readiness potential (LRP) is a component that indexes activity in motor cortex associated with preparing and generating behavioral responses (see Coles et al., 1995), and therefore provides information concerning response output processes. Several LRP studies support the idea that conflict between competing response representations can lead to initial, sub-threshold activation of the incorrect response, followed by (delayed) activation and execution of the correct response (e.g., Gratton et al., 1992, 1988; Smid,

Lamain, Hogeboom, Mulder, & Mulder, 1991; see also Coles et al., 1995). Such occurrences represent conflict in that two opposing responses are activated consecutively within the same experimental trial.

The Current Research

This research was designed to address 3 main goals. First, we sought to determine whether the presence of stereotype-incongruent words, relative to stereotype-congruent words, would slow categorization of faces by race. Second, these studies tested whether the relative probability of stereotype-congruent and -incongruent information would lead to adjustments in processing strategy similar to that reported with traditional flanker tasks (e.g., Bartholow et al., 2005; Carter et al., 2000; Gratton et al., 1992), despite the fact that here the flankers were only indirectly diagnostic of target categories. Finally, we wished to characterize the role of multiple response activation (i.e., response conflict) in these predicted effects. The first experiment tested whether this modified flanker paradigm would elicit behavioral compatibility effects indicative of the occurrence of conflict. In the second experiment, ERPs were added to determine whether the locus of the predicted stereotype compatibility effect was in the stimulus evaluation process or the response output process (or both). If the locus of the effect is in the stimulus evaluation process, P3 latency should mirror reaction times (i.e., longer on incompatible than compatible trials). In contrast, if the effect stems from conflict arising during the response process, P3 latency should be unaffected by flanker compatibility but the N2 and/or LRP should show effects indicative of conflict.

EXPERIMENT 1

METHOD

Participants

White male and female undergraduates ($N = 20$; 11 women) at a large, public university participated for course credit. All participants were healthy (i.e., reported no major medical conditions, including head injury or neurological disorders) and right-handed and had normal or corrected-to-normal vision. Two to six participants at a time completed the experiment in individual rooms.

Stimuli and Experimental Paradigm

Both experiments used a modification of the Eriksen flanker task (e.g., Eriksen & Eriksen, 1974). Each trial consisted of a 200 ms pre-stimulus baseline period followed by central presentation of a target picture surrounded by four words (flankers; presented above, below, left, and right of the target) for 250 ms. Targets consisted of faces of Black and White men; pretesting showed all faces to be similar in attractiveness and likeability. The flankers were positive words (*smart, rich, success, scholar, educate, wealth, honest, bright, safe, truth, loyal, kind*) and negative words (*stupid, poor, messy, violent, lazy, danger, threat, rude, loud, harm, deceive, crime*) associated with common stereotypes for Whites and Blacks, respectively, adapted from previous research (e.g., Lepore & Brown, 1997; Wittenbrink, Judd, & Park, 1997). On any given trial, the four flanker words were the same (e.g., "stupid" appeared

in all four locations). At a distance of 90 cm, the stimulus arrays subtended a visual angle of 10.17 degrees.

Participants completed eight blocks of 90 trials. Trials were separated by an inter-stimulus interval of 1000 ms; a 60 sec break was inserted between blocks. Participants were instructed to racially categorize the targets by pressing one of two keys (counterbalanced across participants) while attempting to ignore the flankers. *Compatible trials* were defined as those in which the race of the target and the valence of the flankers were stereotypically congruent (i.e., Black with negative; White with positive). *Incompatible trials* were defined as those in which target race and flanker valence were stereotypically incongruent (Black with positive; White with negative). The probability of compatible and incompatible trials was manipulated across blocks to produce *expect-compatible* (EC; 80% compatible trials) and *expect-incompatible* (EI; 20% compatible trials) conditions (see Gratton et al., 1992); note that participants were not informed of this manipulation. White and Black targets occurred with equal frequency in each block.

Procedure

Upon arrival, participants first completed informed consent forms. A female experimenter then explained that the study was designed to assess the control of attention during facial recognition. After receiving verbal instructions, participants completed a short practice block consisting of 40 trials in which all trial types were equally probable before completing the experimental blocks. When all blocks were completed, participants were debriefed and dismissed.

RESULTS AND DISCUSSION

Trials in which incorrect categorizations were made (< 8% on average) were excluded from the response time averages prior to analysis. Preliminary analysis indicated that responses did not differ according to participants' sex. Thus, correct categorization response times (RTs) were analyzed using a 2 (compatibility; compatible trials, incompatible trials) \times 2 (expectancy; expect-compatible, expect-incompatible) \times 2 (target race; Black, White) repeated measures ANOVA.¹ As predicted, compatible trials elicited faster categorizations ($M = 455$ ms) than incompatible trials ($M = 464$ ms), $F(1, 19) = 10.50$, $p < .004$, $\eta^2 = .36$. This main effect was qualified by a significant Expectancy \times Compatibility interaction, $F(1, 19) = 9.35$, $p < .007$, $\eta^2 = .33$. Planned comparisons showed that the compatibility effect was larger in the EC condition, $t(19) = 4.97$, $p < .01$, $d = 1.14$, than in the EI condition, $t(19) = 0.96$, $p > .50$, $d = 0.22$ (see Table 1). No other effects were significant.

Gratton et al. (1992) first discovered that the size of the compatibility effect is weaker on trials that follow an incompatible trial compared to those that follow a compatible trial (see also Botvinick, Nystrom, Fissell, Carter, & Cohen, 1999; Kerns

1. An ancillary analysis using logged response times produced essentially identical results. For simplicity, we opted to present the untransformed data. Also, although we did not expect target race to significantly interact with the effects of interest in these studies, it was included where possible because it was a key factor in the design of these experiments.

TABLE 1. Mean Response Latencies in Both Experiments and Mean P3 Latency in Experiment 2 as a Function of Expectancy and Compatibility Conditions

	Expect-Compatible	Expect-Incompatible
RT: Experiment 1		
Compatible	454 _a (55)	457 _a (56)
Incompatible	467 _b (59)	460 _a (60)
RT: Experiment 2		
Compatible	472 _a (59)	473 _a (66)
Incompatible	484 _b (66)	475 _a (69)
P3 Latency: Experiment 2		
Compatible	428 _a (49)	433 _a (64)
Incompatible	436 _a (78)	419 _a (46)

Note. RT = reaction time. All numbers are in ms; numbers in parentheses are standard deviations. Numbers within each group that do not share a subscript differ by at least $p < .05$.

et al., 2004). This finding has been interpreted as evidence that participants use cognitive control to adjust their behavior following the experience of conflict (e.g., Kerns et al., 2004). We tested for this effect in the current data by computing separate averages per condition for trials that followed compatible vs. incompatible trials, and then calculating the compatibility effect (incompatible RT—compatible RT) as a function of previous trial type. These averages were subjected to a 2 (expectancy) \times 2 (target race) \times 2 (previous trial type) repeated measures ANOVA. The effect of previous trial type was significant, $F(1, 19) = 13.1, p < .01$. The compatibility effect was larger on trials that followed compatible trials ($M = 15$ ms) than on trials that followed incompatible trials ($M = 2$ ms), $d = 0.57$. No other effects were significant.

Findings from Experiment 1 are consistent with the idea that stereotype-incongruent flankers elicited response conflict in a manner similar to traditional flanker tasks (e.g., Gratton et al., 1988, 1992), despite the fact that the flanker words were not directly mapped to any task response. Furthermore, the compatibility effect was much larger ($d = 1.14$) in the expect-compatible blocks than the expect-incompatible blocks ($d = 0.22$), suggesting that the degree of conflict experienced in this task was dependent upon participants' response strategies. When flanker information was likely to provide predictive utility concerning target race, participants appeared to extract information from the entire stimulus array to prepare responses. However, when the flankers were unlikely to provide valid information concerning target race, participants appeared to narrow their focus of attention on the target, thereby experiencing less interference from the flanker words (see Gratton et al., 1992).

Although these behavioral results are suggestive of response conflict occurring on incongruent trials, more definitive evidence could be gained by testing whether these behavioral effects correspond to neural activity indicative of conflict. As mentioned previously, the N2 component of the ERP often is considered a neural reflection of conflict monitoring (e.g., Botvinick et al., 2001; van Veen & Carter, 2002), whereas the LRP is thought to reflect activity in motor cortex associated with preparation for executing behavioral responses (Coles et al., 1995), and in previous research has revealed conflict in terms of consecutive activation of op-

posing response tendencies within the same trial (e.g., Gratton et al., 1988, 1992; Smid et al., 1991). Thus, although both components are associated with conflict, the N2 and the LRP reflect somewhat different aspects of this phenomenon. Specifically, whereas the N2 can index the degree of conflict elicited by a particular stimulus, the LRP provides information concerning the timing of motor response activations that could give rise to conflict. Whether behavioral congruency effects are associated with one or the other or both of these components has important implications for refinement of the response conflict account of this effect. Additionally, measuring P3 latency permits a test of whether stimulus evaluation time differs across compatible and incompatible conditions, which could suggest an additional mechanism for the behavioral effects observed in the first experiment.

EXPERIMENT 2

METHOD

Participants

White male and female undergraduate students ($N = 22$; 11 female) at a large, public university participated in exchange for course credit in their introductory psychology course. All participants were right-handed, had normal or corrected-to-normal vision, and reported themselves in good health. Sessions included only one participant at a time.

Stimuli and Experimental Paradigm

All aspects of the stimuli and experimental task were identical to Experiment 1, with the exception of EEG recording, described next.

Electrophysiological Recording

The EEG was recorded from 28 tin electrodes fixed in an electrode cap (Electrocap, International) according to standard placement conventions (American Encephalographic Society, 1994). All cap electrodes were referenced online to the right mastoid; an average reference was derived offline. In addition, vertical and horizontal eye movements (EOG) were recorded with electrodes placed above and below the left eye and 2 cm lateral to the outer canthus of each eye, respectively. Ocular artifacts were corrected off line using a regression-based procedure (Semlitsch, Anderer, Schuster, & Presslich, 1986). A ground electrode was located along the midline, near the front of the cap. The impedance on all electrodes was less than 5 k Ω . EEG and EOG were sampled at 250 Hz using a Neuroscan Synamps amplifier (Compumedics, El Paso, TX) and were filtered online at .01 to 40 Hz. Grand average waveforms were further filtered offline at 12 Hz (low-pass; 12 dB roll-off).

For current purposes, analyses of each component of interest were restricted to the electrode at which they were maximal. Visual inspection of individual participant waveforms was used to determine the epochs for defining specific components. The N2 was defined as the largest negative peak at the fronto-central midline (FCz) electrode between 200-380 ms post-stimulus, as in previous research (see Nieuwenhuis et al., 2003). P3 latency was defined as the latency of the largest positive peak at the parietal midline (Pz) electrode between 400-900 ms post-stimulus. The LRP typically appears in electrodes placed over areas of motor cortex (i.e.,

just lateral to midline over central scalp locations; C3 on the left; C4 on the right), which was the case here. As a participant prepares to make a motor response, a negativity develops in the ERP that is largest at scalp sites contralateral to the responding hand. The LRP is calculated by first subtracting the potential recorded at the scalp site ipsilateral to the movement (e.g., C3 for left-hand responses) from that contralateral to the movement (e.g., C4 for left-hand responses), and then averaging these difference potentials for left- and right-hand movements. According to Coles et al. (1995), when these procedures are performed with reference to the correct response hand in each condition, negative deflections in the waveform reflect preferential activation of the correct response, whereas positive deflections indicate preferential activation of the incorrect response.² Of primary interest here was that portion of LRP developing shortly after stimulus onset, which shows the extent to which initial response activation was correct or incorrect (see Gratton et al., 1988, 1992). Here, initial response activation was measured as the mean amplitude of the LRP 50-150 ms post-stimulus on trials where the correct behavioral response ultimately was emitted.

RESULTS AND DISCUSSION

Response Time

As in Experiment 1, only correct response trials were included in the analysis of RT data. Preliminary analysis again showed no differences as a function of participants' sex. Thus, correct trial RTs were analyzed using a 2 (compatibility) \times 2 (expectancy) \times 2 (target race) repeated measures ANOVA. The analysis showed that congruent trials ($M = 472$ ms) again elicited faster categorizations than incongruent trials ($M = 481$ ms), $F(1, 21) = 9.43$, $p < .006$, $\eta^2 = .31$. The Expectancy \times Compatibility interaction also was significant, $F(1, 21) = 8.55$, $p < .008$, $\eta^2 = .29$. The compatibility effect was again larger in the EC condition, $t(21) = 4.68$, $p < .001$, $d = 1.04$, than in the EI condition, $t(21) = 0.73$, $p = .47$, $d = 0.16$ (see Table 1). No other effects of interest were significant in this analysis.³

The effect of previous trial type (compatible vs. incompatible) on the size of the compatibility effect was again analyzed using a 2 (Expectancy) \times 2 (Target race) \times 2 (Previous trial type) repeated ANOVA. This analysis produced a significant effect of Previous trial type, $F(1, 21) = 13.9$, $p < .01$. The compatibility effect was again larger following compatible trials ($M = 16.1$ ms) than following incompatible trials ($M = 1.4$ ms), $d = 0.56$. No other effects were significant in this analysis.

2. The formula for deriving the LRP is as follows (see Coles et al., 1995):

$$\text{LRP} = [\text{Mean}(C4' - C3')_{\text{left-hand response}} + \text{Mean}(C3' - C4')_{\text{right-hand response}}] / 2$$

3. The analysis also produced an unexpected Target Race \times Expectancy interaction, $F(1, 21) = 4.38$, $p < .05$. Inspection of the means indicated that whereas expectancy condition had no effect on RTs to White targets overall ($M_s = 475$ ms in both EC and EI conditions), participants were slower to categorize Black targets in the EC condition ($M = 481$ ms) than in the EI condition ($M = 472$ ms). No other effects were significant. This effect was unpredicted, did not emerge in the first experiment, and is irrelevant to our main hypotheses and so will not be discussed further.

ERPs

ERP data from two participants were unusable due to a high proportion of EEG artifacts. Thus, ERP analyses were based on data from 20 participants. N2 amplitude and P3 latency data were analyzed using separate 2 (Compatibility) \times 2 (Expectancy) \times 2 (Target race) repeated ANOVAs. Due to the nature of the calculations of the LRP, the ANOVA on those data did not include the Target race factor. Specifically, the denominator of the LRP formula (see Footnote 2) requires that the movement potentials for both target responses (i.e., White targets and Black targets) be averaged. Thus, given that left-hand and right-hand responses were assigned to one race category or the other (counterbalanced across participants) for each participant, the target race factor was effectively averaged out of the equation when averaging left-hand and right-hand movements.

N2. As predicted, N2 amplitude was larger on incompatible ($M = -2.79 \mu\text{V}$) compared to compatible trials ($M = -1.42 \mu\text{V}$), $F(1, 19) = 4.44, p < .05, \eta^2 = .19$, consistent with the idea that conflict was detected when flanker words were stereotypically incongruent with the race of the target. This effect was not further qualified by Expectancy, $F(1, 19) = 0.53, p = .66$ (see Figure 1). In addition, and consistent with previous research using White participants (e.g., Dickter & Bartholow, 2007; Ito & Urland, 2003, 2005), White targets ($M = -2.55 \mu\text{V}$) elicited larger N2s than Black targets ($M = -1.66 \mu\text{V}$), though this difference was marginally nonsignificant, $F(1, 19) = 3.72, p < .07, \eta^2 = .16$. No other effects were significant.⁴

P3. The ANOVA examining P3 latency showed no significant effects, including the Expectancy \times Compatibility interaction, $F(1, 19) = 1.32, p = .26, \eta^2 = .06$ (see Table 1). This finding suggests that evaluative categorization of targets was largely unaffected by both the probability and the presence of incongruent flankers. If anything, the P3 latency means shown in Table 1 suggest a simple expectancy violation effect, with longer latencies for less probable stimulus arrays regardless of compatibility.

LRP. The ANOVA on the LRP amplitude data showed a significant Expectancy \times Compatibility interaction, $F(1, 19) = 12.63, p < .01, \eta^2 = .40$. As shown in Figure 2, relative to congruent trials, incongruent trials tended to initially elicit the incorrect categorization response when congruent trials were more probable (80% compatible condition), $t(19) = 4.10, p < .01, d = .92$. This pattern was not evident when incongruent trials were more probable (20% compatible condition), $t(19) = -1.70, p > .05, d = .38$. These data indicate that incongruent flankers generated conflict in response channels resulting from initial activation of the incorrect response followed by activation of the correct response (i.e., consecutive response activation) when congruent flanker trials were more probable. No other effects were significant.

4. Although this target race effect in the N2 was not of central interest in the current report, it is worth noting that, across multiple studies, ingroup racial cues have elicited enhanced N2 amplitude relative to outgroup racial cues (e.g., Dickter & Bartholow, 2007; Ito, Thompson, & Cacioppo, 2004; Ito & Urland, 2003, 2005). In most such studies (as in the current study), research participants have been White, and thus the N2 has been enhanced to White vs. Black targets. Dickter and Bartholow (2007) recently found the opposite pattern among Black participants, suggesting that the N2 is sensitive to processing of ingroup cues in tasks involving targets that vary by race. A more thorough discussion of possible reasons for this effect can be found in these other sources (e.g., Dickter & Bartholow, 2007; Ito & Urland, 2003).

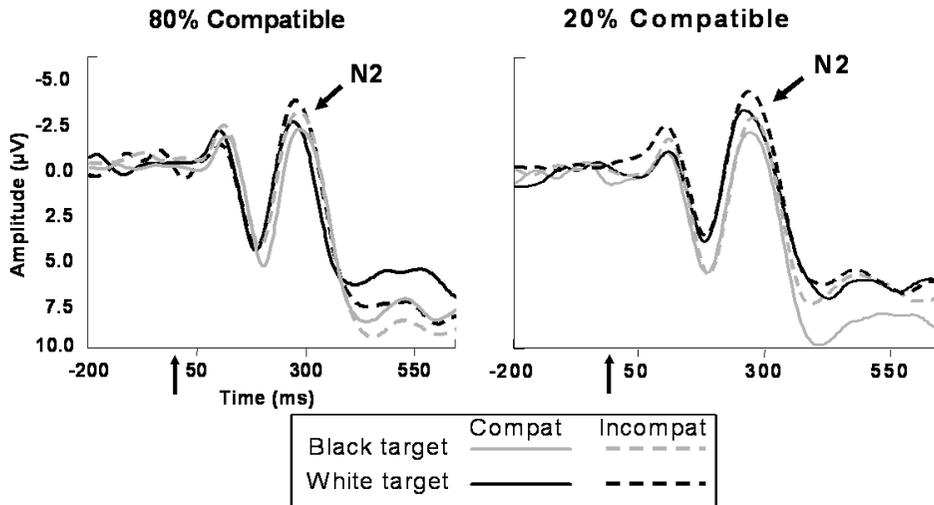


FIGURE 1. N2 amplitude as a function of target race, compatibility, and expectancy conditions: Experiment 2. The vertical arrow on the timeline represents onset of the stimulus array. Compat = compatible (stereotype-congruent) trials; Incompat = incompatible (stereotype-incongruent) trials.

The analyses presented thus far indicate that categorization responses were slower on incongruent compared to congruent flanker trials, and that incongruent trials elicited neural activity indicative of response conflict. To test whether this neural activity was associated with differences in behavioral responding, we correlated the compatibility effect in RT (incongruent trials RT-congruent trials RT) with the same effect measured in early LRP amplitude, separately for EC and EI conditions. As shown in Figure 3, these difference scores were significantly positively correlated in the EC condition, $r = .45, p < .05$, indicating that as the tendency to initially activate the incorrect response increased (reflected in the positive deflection early in the LRP waveform in the left panel of Figure 2), responses became slower. These scores were not significantly correlated in the EI condition ($r = -.28, p > .40$). Similar correlations involving N2 amplitude and RT difference scores were uncorrelated in both EC ($r = -.24, p > .30$) and EI conditions ($r = -.05, p > .80$), as were correlations between P3 latency and RT difference scores ($r_s = .06$ & $.19, p_s > .40$, in EC and EI conditions, respectively). These data suggest that the slower responses seen on incongruent trials were related to conflict during response generation, but not to conflict detection or to differential stimulus evaluation.

The data from Experiment 2 provide additional support for a response conflict account of stereotype congruency effects during racial categorization. The behavioral findings mirrored those of Experiment 1, and the electrocortical data strongly implicated both conflicting response activation in motor cortex (LRP) on stereotype-incongruent categorization trials and the detection of this conflict by the conflict monitoring system (N2). Also similar to Experiment 1, the compatibility effect was much larger in the expect-compatible than in the expect-incompatible condition, suggesting again that the degree of conflict in this task was related to the ex-

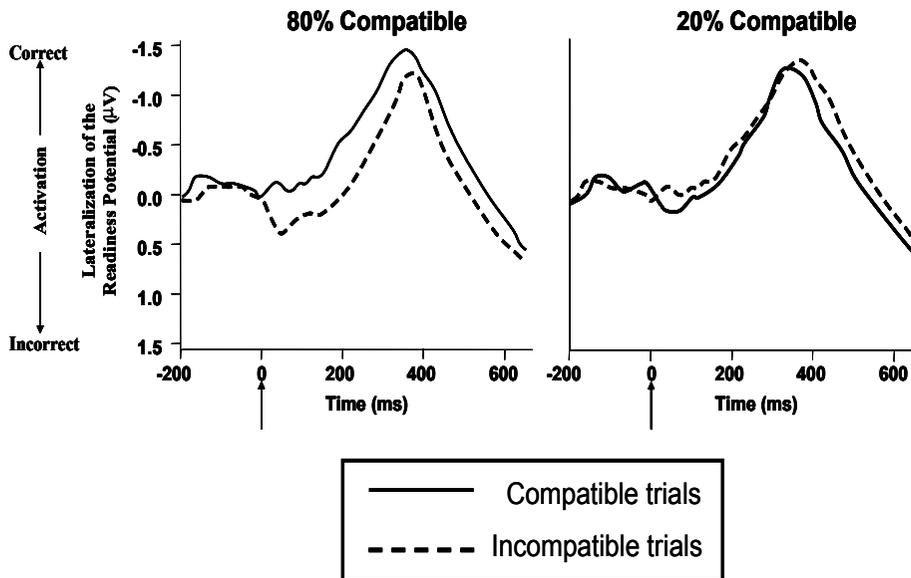


FIGURE 2. Lateralized readiness potential (LRP) waveforms as a function of compatibility and expectancy (probability) conditions. The vertical arrow on the timeline represents onset of the stimulus array. Of primary interest here was the amplitude of the LRP shortly after stimulus onset (50-150 ms post-stimulus). The formula used to derive the LRP is applied with reference to the correct response hand on each group of trials, such that negative (upward) deflections reflect preferential activation of the correct response, whereas positive (downward) deflections indicate preferential activation of the incorrect response.

tent to which participants relied on the probability of stereotype-congruent flanker words when making responses. That this pattern was reflected in early LRP amplitude but not P3 latency points to conflict in response preparation as the locus for the compatibility effect in RT, and casts doubt on the possibility that this effect was the result of differential evaluative categorization on incongruent trials.

GENERAL DISCUSSION

The studies reported here tested the hypothesis that the presence of stereotype-incongruent information would slow categorization of faces by race. The response latency data from both experiments support this hypothesis. This finding is conceptually similar to other research showing that participants' responses to category members are slower for targets whose behavior (e.g., Kernahan, Bartholow, & Bettencourt, 2000), facial features (e.g., Livingston & Brewer, 2002), or evaluative characteristics (e.g., Richeson & Trawalter, 2005) are atypical of or inconsistent with their category. The current findings extend this prior work by showing how participants use available information when responding to racial categories. Similar to other research using more typical flanker tasks (e.g., Bartholow et al., 2005; Gratton et al., 1992), the current data suggest that the use of information in racial categorization is driven by the probability that available stimuli (stereotype-related words, in this case) will aid in identifying the target. When the probability is high that additional information will facilitate the correct categorization, participants appear to direct attention broadly to the entire stimulus array, and to ex-

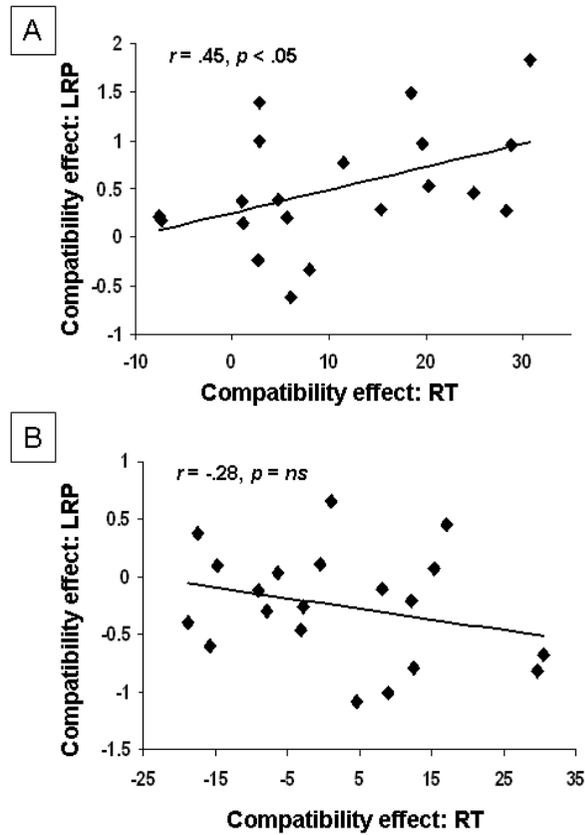


FIGURE 3. Correlations between the compatibility effect (incompatible trials – compatible trials) in response time and the amplitude of the lateralized readiness potential (LRP) occurring 50-150 ms post-stimulus, separately for expect-compatible (panel A) and expect-incompatible (panel B) conditions. The significant association in the expect-compatible condition indicates that as amplitude of the early LRP in the incompatible (relative to compatible) condition became more positive (indicating activation of the incorrect response), responses on incompatible (relative to compatible) trials became slower.

tract and use the information provided by the peripheral stimuli to guide response preparation. When additional information is not likely to facilitate the correct response, participants appear to focus attention more narrowly on the target. Klauer, Rossnagel, and Musch (1997) similarly argued that, when judging the valence of stimuli, participants will strategically allocate attention to distracters if chances are good that they will be affectively congruent with the target and thereby provide predictive validity. However, given that we did not directly measure attention allocation in these experiments, and that these studies did not directly test this response strategy interpretation against other plausible hypotheses (e.g., that a high probability of stereotype-congruent trials heightens stereotype accessibility, which

could magnify differences in response conflict between conditions), this interpretation should be viewed with some caution.

Perhaps most importantly, the current data help to clarify the role of a neurocognitive mechanism—response conflict—in slowed responses on stereotype-incongruent trials in tasks like this. The three ERP components measured in Experiment 2 all provided distinct information concerning the processing of congruent and incongruent stimulus arrays. Of these components, the LRP appeared to best characterize the processes that produced the conflict evident in the compatibility effects in behavior. The amplitude of the early LRP clearly indicated a tendency for participants to initially activate the incorrect categorization response on incompatible trials in the EC condition but not the EI condition. This pattern mirrored the RT results, which showed a significant compatibility effect only in the EC condition. Moreover, the extent of this initial incorrect response activation was correlated with the size of the behavioral compatibility effect. The N2 (conflict monitoring) component was enhanced on high-conflict (incompatible) compared to low-conflict (compatible) arrays, reflecting that the consecutive response activations seen in the LRP produced conflict (see Botvinick et al., 2001; Yeung, Botvinick, & Cohen, 2004), but was not affected by conflict probability. Taken together, the current pattern of LRP and N2 effects suggests a conceptual dissociation between these two indices. Although the N2 appears to reflect the degree of conflict on particular trials, it is not related to how participants use the (flanker) information that produces the conflict in preparing to make responses. The LRP, in contrast, appears to reflect the extent to which participants find this information useful in making responses, in terms of whether there appears to be an association between the information extracted from the flankers and the information needed to correctly identify the target.

In contrast to the N2 and LRP, the latency of the P3 was not sensitive to compatibility effects in the current research. When flankers are directly mapped to responses, P3 latency often correlates with the compatibility effect in reaction time (e.g., Coles et al., 1985), suggesting a role for stimulus evaluation in compatibility effects. However, in the current data P3 latency was uncorrelated with response time. The current findings are similar to results reported by Smid et al. (1991). Like the current study, these researchers found that incongruent trials elicited initial activation of the incorrect response as revealed by the LRP. However, in a condition in which the non-target (distracter) stimuli had no experimentally defined response but could merely share some features with the target, P3 latency was unaffected by compatibility although the compatibility effect in RT was still present (see also McCarthy & Donchin, 1981). Still, as others have pointed out (e.g., Gratton et al., 1988), stimulus evaluation can contribute to conflict effects. Early, cursory evaluation of a stimulus is used to inform initial response preparation, which can lead to conflict if continuing stimulus evaluation eventually indicates that the opposite response should be made. In the current data, the initial evaluation of stimulus arrays, driven largely by the flankers, appears to have been instrumental in eliciting the initial incorrect response activation we observed in the LRP on incompatible trials.

The current data also add to a growing body of evidence indicating that response conflict and cognitive control processes play a key role in regulating responses to

racial categories (see Amodio et al., 2004, 2006; Cunningham et al., 2004; Payne, 2005; Payne et al., 2005). The general consensus emerging from these recent studies is that regulatory control processes can modulate responses associated with automatic race bias. The current data are consistent with this idea, but also provide important new information concerning the manner in which conflict can arise to produce observed behavioral effects. Specifically, our data indicate that response preparation can be influenced at a very early stage by peripheral, non-target information, to the extent that participants expect it to aid target identification. Processing this peripheral information leads to conflict when it suggests a response opposing the one called for by the current target. Moreover, unlike in some other tasks (e.g., Payne, 2001, 2005; see also Amodio et al., 2004), the conflict effects seen here cannot be attributed to a sequential presentation of stimuli. That is, although the conflict resulted from temporal patterning of consecutive response activations within individual trials, the stimuli that produced this conflict (i.e., the flankers) did not temporally precede the targets.

Taken together, the pattern of behavioral and electrocortical data from these studies supported the hypothesis that conflict occurring during response output is an important mechanism underlying slowed responses on stereotype-incongruent trials in reaction time tasks. However, it is important to acknowledge the role played by other processes in the broader phenomenon under investigation here. Specifically, in order for stereotype-incongruent information to produce conflict, there must first be an association between race categories and attributes (here represented by trait words). These associations are believed to be largely automatic (e.g., see Fiske, 1998), learned through a lifetime of exposure to cultural stereotypes. Thus, the foundation of the conflict effects observed here and in other, similar work (e.g., Amodio et al., 2004; Payne, 2005) is automatic bias, which participants must overcome in order to respond correctly on incongruent trials (see Conrey et al., 2005). In tasks such as the one used here and in similar work (e.g., Payne, 2001), participants can estimate a particular response (e.g., a race category or a gun/tool discrimination) by processing the distracter information simply because stereotypes are well known. If a stereotype is conceptualized in terms of the probability that a target person has particular traits, then processing trait information would produce a bias toward a stereotype-congruent response even though the actual probability of targets (and thus, target responses) is 50 per cent.

As mentioned previously, patterns of response facilitation on stereotype-congruent vs. incongruent trials often have been interpreted as evidence for a spreading activation process (e.g., Dovidio et al., 1997), and it is therefore important to consider whether such a process might have had an influence on the present results. Spreading activation assumes that the presence of one stimulus facilitates responses to other stimuli that share meaning, valence, or some other key attribute because those stimuli are more closely linked in memory (see Neely, 1977). Thus, the activation of one construct "spreads" more quickly to related (e.g., stereotype-congruent) constructs than to unrelated constructs. Here, that process would manifest in quicker responses on compatible than on incompatible trials, just as we observed. However, the N2 and LRP amplitude data in Experiment 2 highlight an important role for conflict in response output in this process, and thus the purely associative account implied by spreading activation is insufficient to explain the behavioral findings observed here. Thus, the current data suggest that response

conflict be considered alongside spreading activation as an important mechanism of response differences in stereotyping and categorization tasks.

In conclusion, the current results demonstrate an important role for response conflict in stereotype-congruency effects often seen in response time data. These results add to the findings of a number of recent, related studies (e.g., Amodio et al., 2004; Conrey et al., 2005; Payne, 2005) by clarifying the manner in which participants use available information to prepare and activate responses, and demonstrating how conflicting responses can arise within the same trial when some of that information is stereotypically-incongruent with a relevant target. Finally, these findings suggest that, at least in some cases, the associations between categories and attributes in long-term memory produce differential responding on stereotype-congruent and -incongruent trials in RT tasks because incongruent trials elicit conflicting response activations. It does not appear that a spreading activation account can adequately explain the patterns of data observed here. Thus, these data might call for reconsideration of typical "priming" effects in terms of response output processes in addition to stimulus evaluation processes.

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